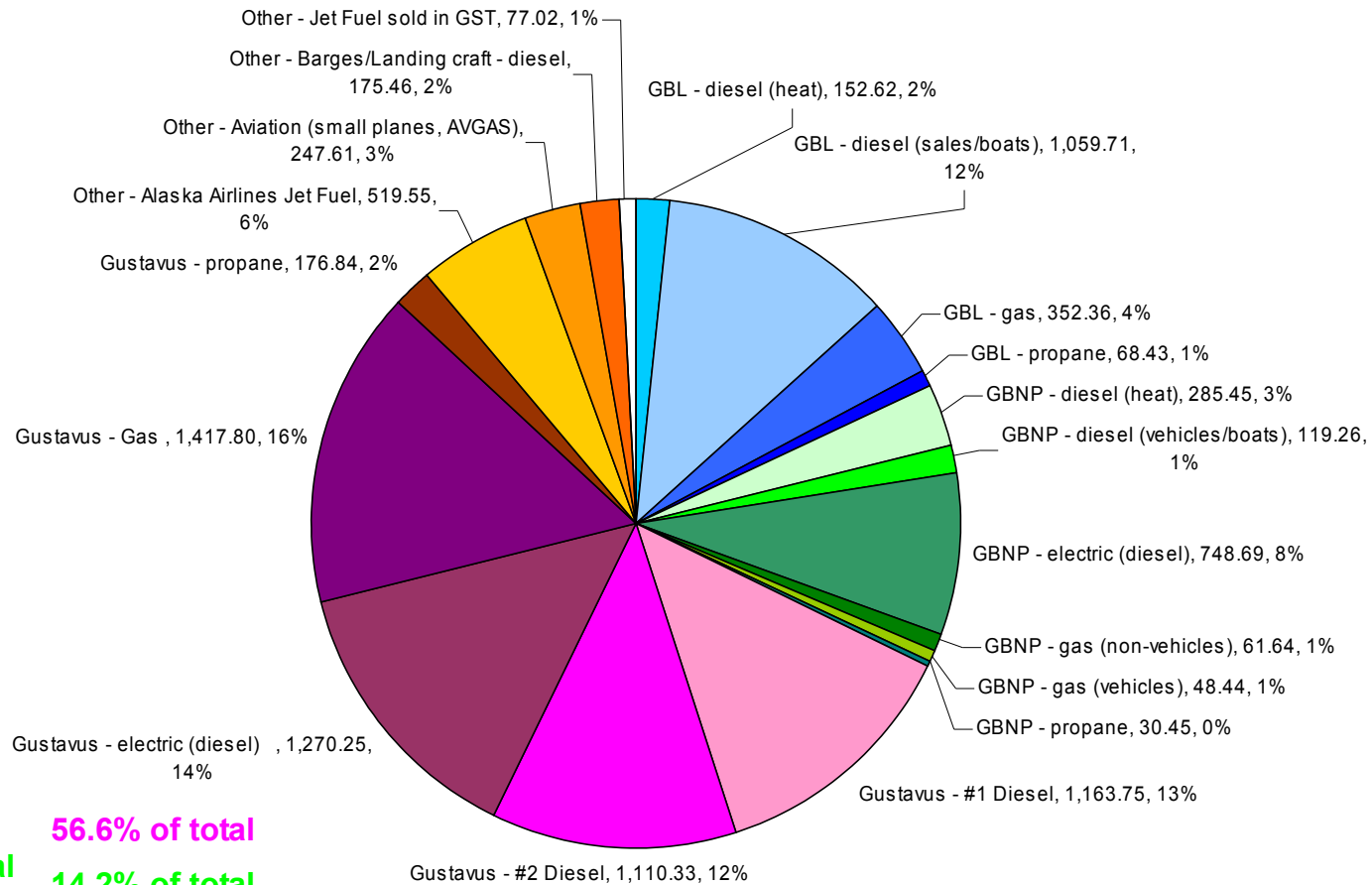


## C0<sub>2</sub>e emissions by source in Gustavus in 2006

(metric tons of CO<sub>2</sub>e and percent of total)\*



**Gustavus** 56.6% of total  
**Glacier Bay National Park and Preserve** 14.2% of total  
**Glacier Bay Lodge** 18.0% of total  
**Other** 11.2% of total

**Not included in calculations for Gustavus:** wood heat (which is generally considered carbon neutral, see pg 4); cruise ships and other vessels not purchasing fuel in Gustavus.

\* CO<sub>2</sub>e stands for “carbon dioxide equivalent.” It is a measurement where all the greenhouse gases are converted to their warming equivalent in terms of CO<sub>2</sub>.

<b>Gustavus Fossil Fuel Use</b>	<b>Quantity Consumed 2006</b>	<b>Pound CO2e</b>	<b>Metric Tons CO2e</b>	<b>Estimated Cost</b>
<b>Gustavus</b>				
#1 Diesel (mostly home heating)	119,220 gal	2,565,612	1,163.75	\$371,966.40
#2 Diesel (heating, some vehicles and boats)	109,350 gal	2,447,835	1,110.33	\$341,172.00
Electric Generation (diesel)	125,100 gal	2,800,404	1,270.25	\$390,312.00
Gasoline (75% vehicle, 25% boats)	160,950 gal	3,125,686	1,417.80	\$564,934.50
Propane	131,478 lb/30,965 gal	389,857	176.84	\$152,514.48
<b>Glacier Bay National Park and Preserve</b>				
Diesel (heat)	29,243 gal	629,309	285.45	\$91,238.16
Diesel (vehicles/boats)	11,745 gal	262,916	119.26	\$36,644.40
Electric Generation (diesel)	73,734 gal	1,650,560	748.69	\$230,050.08
Gasoline (non-vehicles)	6,997 gal	135,883	61.64	\$24,559.47
Gasoline (vehicles)	5,499 gal	106,792	48.44	\$19,301.49
Propane	22,640 lb/5,332 gal	67,132	30.45	\$26,262.40
<b>Glacier Bay Lodge</b>				
Diesel (heat)	15,635 gal	336,465	152.62	\$48,781.20
Diesel (sales/boats)	104,365 gal	2,336,244	1,059.71	\$325,618.80
Gasoline (boats)	40,000 gal	776,809	352.36	\$140,400.00
Propane	12,000 lb/2,826 gal	150,869	68.43	\$13,920.00
<b>Other Sources</b>				
Alaska Airlines Jet Fuel	62,451 gal	1,145,393	519.55	?
Aviation (small planes, AVGAS)	29,764 gal	545,892	247.61	?
Barges/Landing craft - diesel	17,280 gal	386,818	175.46	\$53,913.60
Jet Fuel sold in GST	7,890 gal	169,793	77.02	?
<b>Total</b>	<b>958,346 gal</b>	<b>20,030,268</b>	<b>9,085.67</b>	<b>\$2,831,588.98</b>
<b>Per capita (pop 450)</b>	<b>2,130 gal</b>	<b>44,511.71</b>	<b>20.19</b>	<b>\$6,064.21</b>

Note: Per capita values assume that permanent residents are responsible for all Gustavus CO2e emissions; in fact, many emissions are due to visitors and seasonal residents.

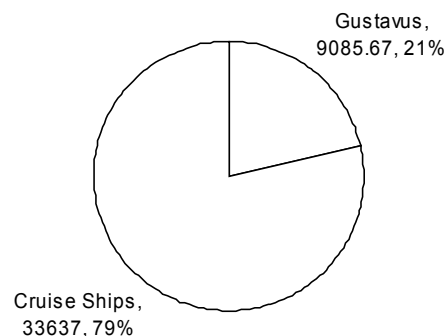
Costs based on average retail process in Gustavus over past 2 years from Whitney Rapp.

Type	CO2e conversion factor	Source
motor gasoline	19.42 lbs CO2/gal or 0.008809 metric tons CO2/gal	<a href="http://www.epa.gov/climatechange/emissions/downloads/2007GHGFastFacts.pdf">http://www.epa.gov/climatechange/emissions/downloads/2007GHGFastFacts.pdf</a>
avgas	18.34 lbs CO2/gal or 0.008319 metric tons CO2/gal	
kerosene (no 1)	21.52 lbs CO2/gal or 0.009761 metric tons CO2/gal	
jet fuel	21.52 lbs CO2/gal or 0.009761 metric tons CO2/gal	
distillate fuel oil (no 2)	22.39 lbs CO2/gal or 0.010154 metric tons CO2/gal	
residual fuel oil	26.02 lbs CO2/gal or 0.011801 metric tons CO2/gal	<a href="http://www.epa.gov/greenpower/pubs/calcmeth.htm">http://www.epa.gov/greenpower/pubs/calcmeth.htm</a>
propane	2.97 lbs CO2/gal or 0.001345 metric tons CO2/lb	

CO2 per capita in metric tons (2004)	
Source <a href="http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions_per_capita">http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions_per_capita</a>	
United States (10th highest)	20.4
Qatar (highest)	69.2
Australia	16.3
Germany	9.79
Sweden	5.89
China	3.84
Bangladesh	0.25

**“Carbon dioxide equivalent” or “CO2e”** is a measurement in which all the greenhouse gases are converted to their warming equivalent in terms of CO2. CO2e for the various fuels are from the U.S. Environmental Protection Agency website, see [www.epa.gov/cleanerenergy/energy-resources/calculator](http://www.epa.gov/cleanerenergy/energy-resources/calculator) or the CO2e conversion factors listed on page 3. It is not intuitively obvious that CO2 emissions would weigh more than the gallon of gas from which the emissions derive. The explanation has to do with the carbon from the fuel combining with oxygen in the air. The molecular weights of carbon and oxygen are 12 and 16, so the molecular weight of CO2 is 44, that is, (12 + [16 x 2]) as compared to 12 for carbon alone. Thus the weight of carbon alone to carbon dioxide is 12/44. Carbon alone weighs approximately 27% as much as carbon dioxide. Some accountings of greenhouse gas emissions are stated in terms of “carbon,” alone, rather than in “carbon dioxide.”

### CO2 Emissions Comparison of Gustavus vs Cruise Ships in Glacier Bay (metric tons CO2e and percent of total)



Cruise ship assumptions: 712 kg CO2/km, Glacier Bay roundtrip 210 km, 225 trips/year

### A personal example - Whitney's house and car

Type	Quantity/Year	\$/Year	Metric Tons CO2e/Year
Car unleaded	89.68 gal	\$314.97	0.79
Electric	1669.76 kw	\$661.28	Conversion factor not yet available
Propane	444.43 lb	\$517.30	0.60
Fuel #1	336.36 gal	\$662.07	2.07
<b>Total</b>		<b>\$2,155.62</b>	<b>3.46</b>

**Purpose:** 1) show how use of fossil fuels around Gustavus contributed to atmospheric CO<sub>2</sub>e in 2006, 2) set a baseline for comparison if emission reductions are attempted, and 3) assess our vulnerability to fossil fuel shortages and cost increases. This is not intended as a true picture of Gustavus residents' "carbon footprint." It *includes* emissions that could appropriately be assigned to visitors and seasonal residents. It *omits* emission occurring far away that pertain to residents' lives, such as jet airplane trips and the manufacture and shipping of goods and food that we use. It also omits our share as U.S. citizens of emissions from the military and from building and operating public facilities. Oil field operations on Alaska's North Slope generate huge emissions; they also provide revenue for our state government and PFD payments. If our "per capita CO<sub>2</sub>e emissions" could be computed, they would be well above the U.S. national average.

#### **Sources of Gustavus Fuel estimates**

1. Gustavus Electric and Gustavus fuel sales: from Dick Levitt, owner/operator of Gustavus Electric and Gustavus Dray. Mr. Levitt provided statistics for the years 2000 through 2006. He stated that #1 diesel consumption varies depending on severity of winters, while #2 diesel use increases in years with major construction projects, with a high of 181,880 gals. for 2002 and a low of 55,840 gals. for 2004. Mr. Levitt also provided Gustavus sales of aviation and jet fuel, but see below for aviation and jet fuel estimates.
2. Glacier Bay Lodge & Fuel Sales: from Cory Child, 2006 Lodge manager.
3. Glacier Bay National Park: GB Nat'l Park Maintenance Division.
4. Propane: Glacier Bay Nat'l Park Maintenance Div.; GB Lodge 2006 manager; Gustavus propane consumption estimated from freight weights.
5. Barges & Landing Craft: Glacier Bay Trucking via contacts with freight operators.
6. Aviation gas for small commercial planes: from six companies operating commercial flights to and from Gustavus. This was done to include fuel sold elsewhere for Gustavus-bound flights. Aviation gas for small private planes: omitted due to difficulty of estimating.
7. Jet Fuel: Fuel sold in Gustavus for private jets from Dick Levitt of Gustavus Dray.

Jet Fuel for Alaska Airlines: Estimate based on information on the Internet that a Boeing 737 jet aircraft burns about 771 gals./hr. Other sources indicate that for short flights about 25% of the fuel is used in take-off. Few jet flights are as short as that from Juneau to Gustavus. According to DOT, there were 81 Alaska Airlines round-trip flights to Gustavus in 2007, so the same figure has been used for 2006. The fuel consumption for Alaska Airlines shown in our inventory is thus 771 gals. x 81 trips = 62,451 gals. **This estimate is less reliable than others in our inventory.** Eventually we hope to get a better estimate from Alaska Airlines.

#### **Wood fuel**

The Inter-governmental Panel on Climate Change protocols for nations to account for greenhouse gas emissions are used by the U.S. Environmental Protection Agency. A 2007 inventory of greenhouse gases prepared for the State of Alaska states: "Emissions estimates from wood combustion include only N<sub>2</sub>O and CH<sub>4</sub>. Carbon dioxide emissions from biomass combustion are assumed to be 'net zero', consistent with US EPA and IPCC methodologies, and any net loss of carbon stocks due to biomass fuel use should be accounted for in the forestry analysis." (footnote, p.36, *Alaska Greenhouse Gas Inventory and Reference Case Projections, 1990-2020*, Alaska Dept. of Environmental Conservation.)

Wood fuel was omitted from the Gustavus fossil fuel inventory because we had no way to estimate the N<sub>2</sub>O and CH<sub>4</sub> component and because few local trees are cut specifically for firewood. Wood burning does produce particulates which affect air quality and that can help darken snow, thus reducing snow albedo (ability to reflect sunlight).

**Cost estimates** These are intended to represent current, rather than 2006, costs. They came from Whitney Rapp's invoices averaged over the past two years.

#### **Decisions About What to Include in This Inventory**

In compiling a fossil fuel and greenhouse gas inventory for our community, we had to decide what to include and what to leave out. This inventory covers fossil fuels used to run our personal lives while we are in Gustavus, and to run our local economy. It does not include cruise ships, although a number of full-time and seasonal National Park jobs are related to cruise ships.

The extensive jet travel by Gustavus residents is largely omitted, even though jet travel is an especially powerful contributor to global warming. Other important omissions: manufacture of goods that we buy, production of food that we import, and the shipping of both of those to Juneau. [Note that shipping miles for food consumed in the U.S. is said to average 1,500 miles, a figure that does not include shipping to Alaska.] The production and operation of distant infrastructure is also omitted, for example our share of the U.S. military.